



Global Mapping of CO₂ Sources and Sinks

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Content of Presentation

- Introduction to IEA GHG
- Global Carbon Capture and Storage Institute (GCCSI)
- IEA GHG Global Emissions Database
- Storage capacity and mapping in regions outside N America
- IEA GHG studies of storage potential in depleted hydrocarbon fields: source-sink matching



IEA Greenhouse Gas R&D Programme



IEA GHG Contracting Parties and Sponsors



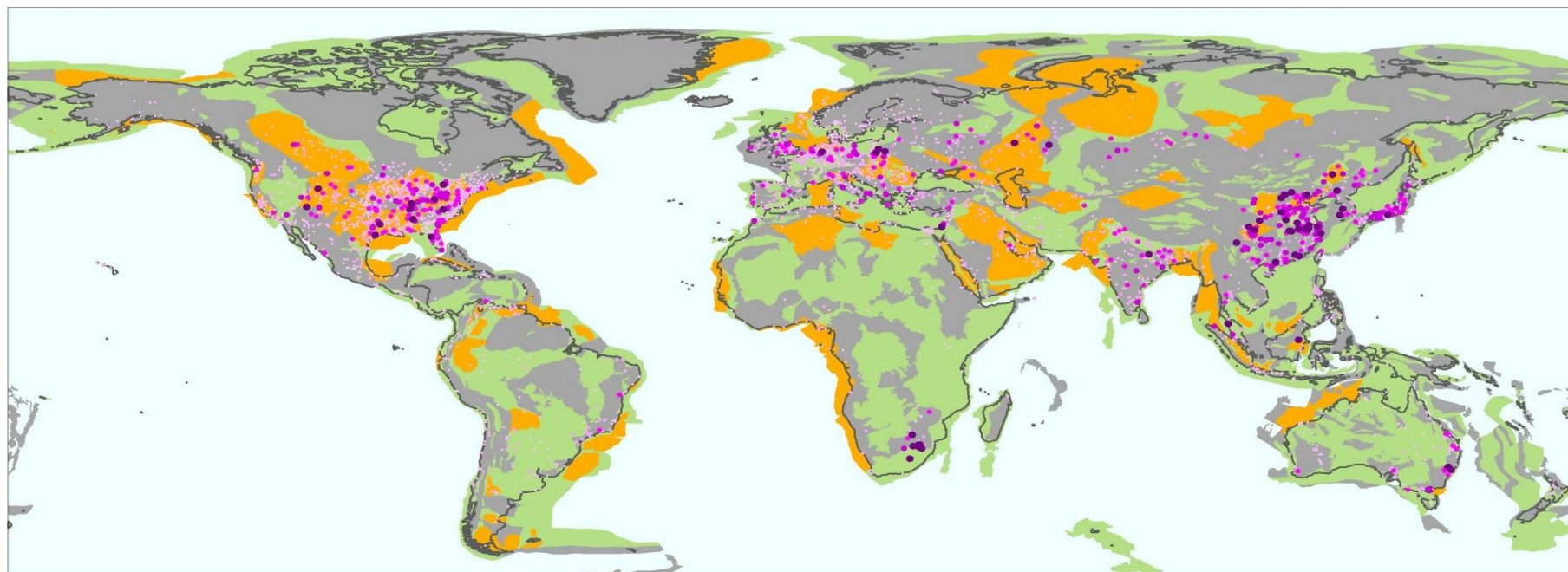


Global Carbon Capture and Storage Institute (GCCSI)

- IEA GHG is a founder member of GCCSI
- GCCSI to be a corporate sponsor of IEA GHG
- IEA GHG to act as research provider for GCCSI
- GCCSI aims to produce an interactive GIS-based global atlas with links to IEA GHG emissions and CCS projects databases
- IEA GHG proposed study on storage atlas








World Emissions



-  Highly Prospective Areas
-  Propsective Areas
-  Non-Prospective Areas
-  Coastline

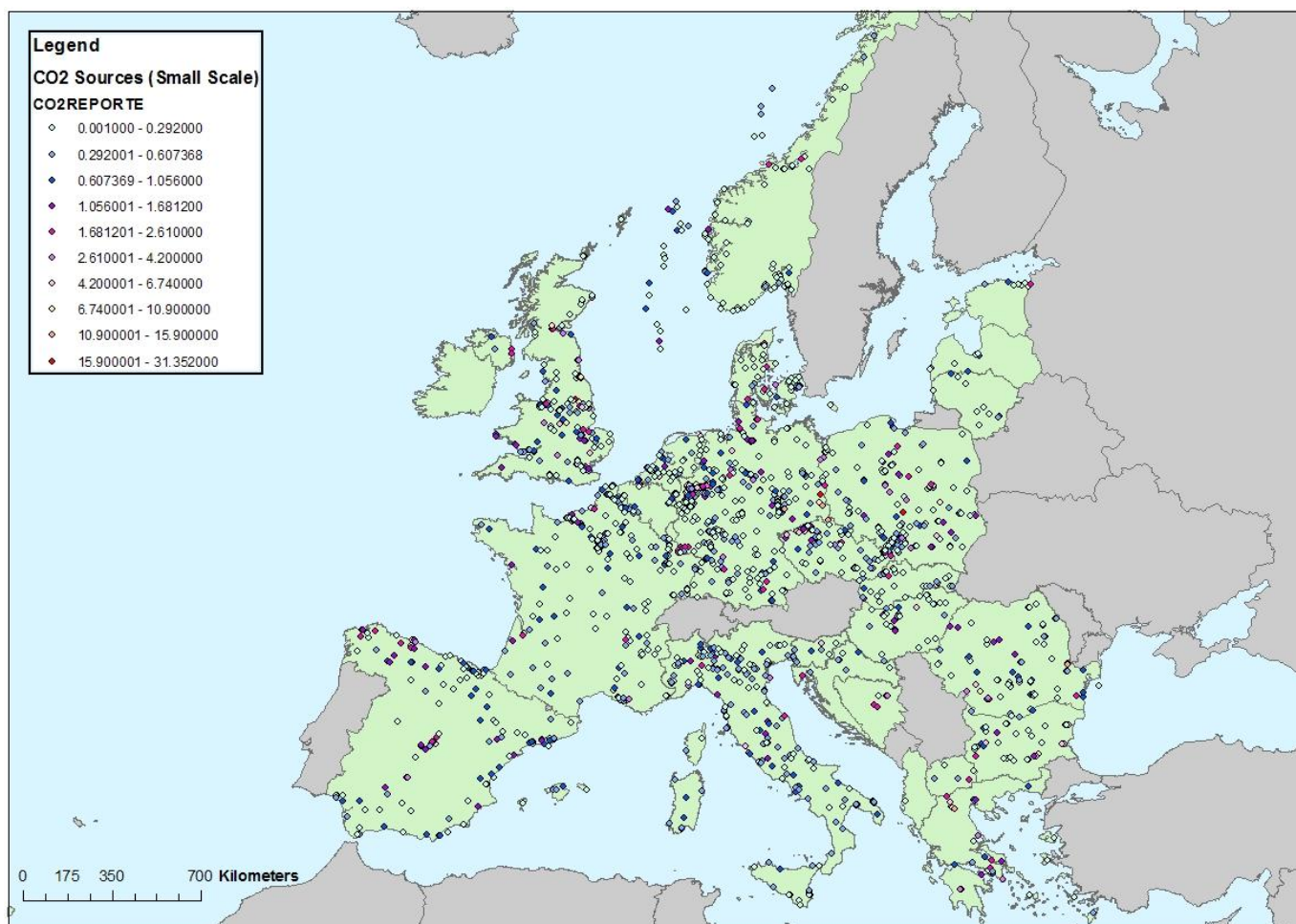
Emission Locations
(kT CO₂ per year)

-  1 - 1000
-  1000 - 5000
-  5000 - 10000
-  10000 - 15000
-  15000 - 50000

0 3000 Km




Europe - EU Geocapacity Project



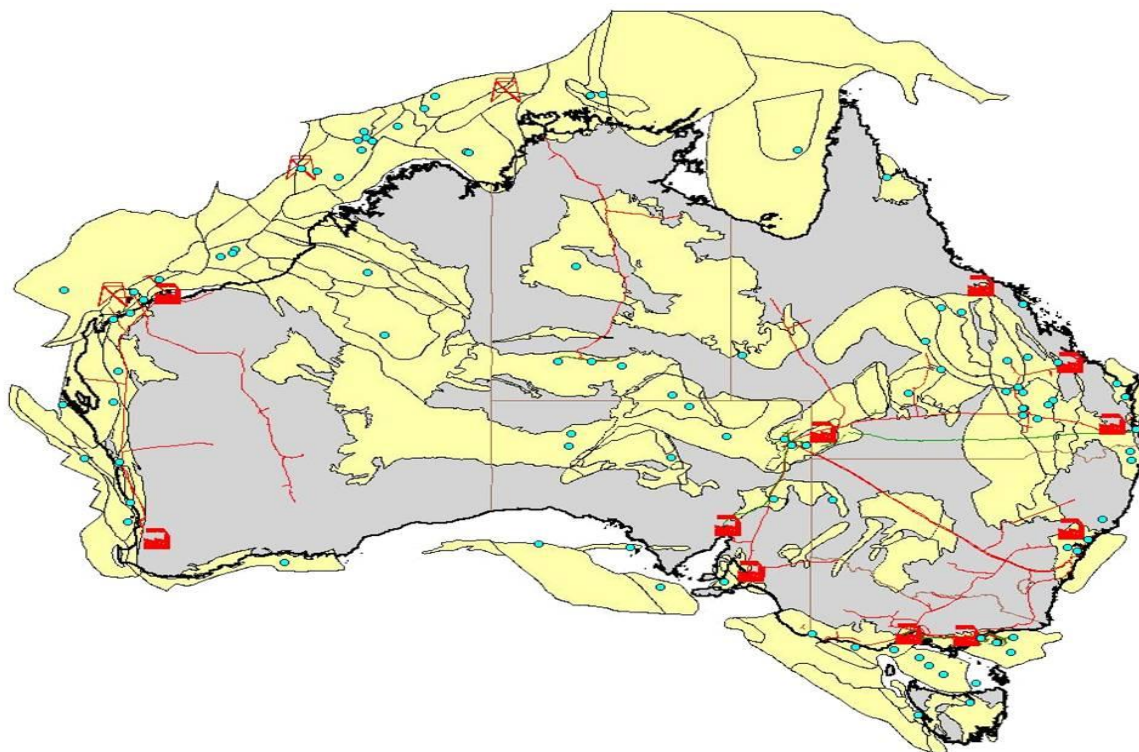


Geocapacity Storage Estimates (Gt CO₂)

Storage Type	'Best'	'Conservative'
Deep saline formations	326	96
Depleted HC fields	32	20
Coal beds	2	1
TOTAL	360	117

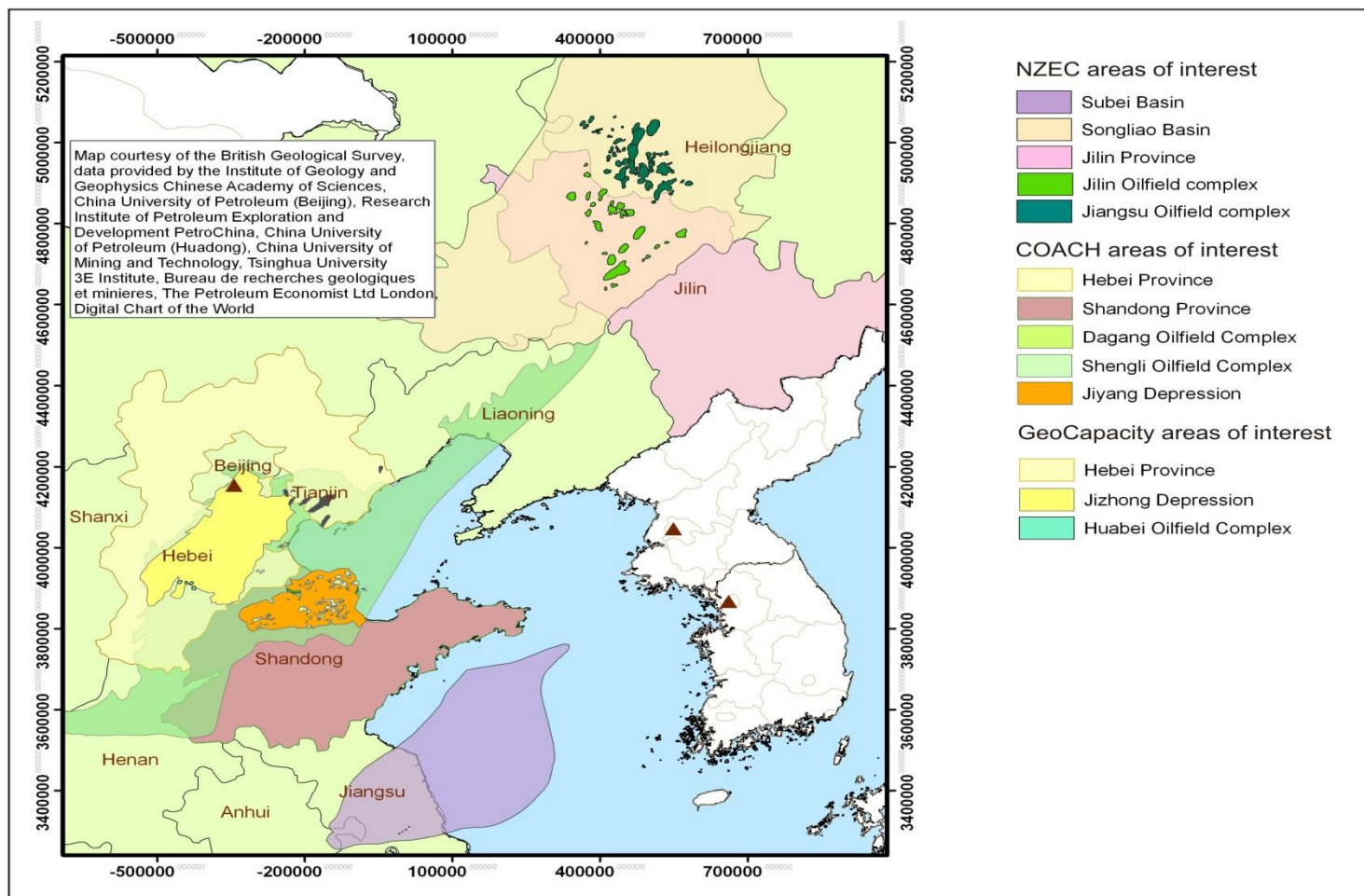


Australia



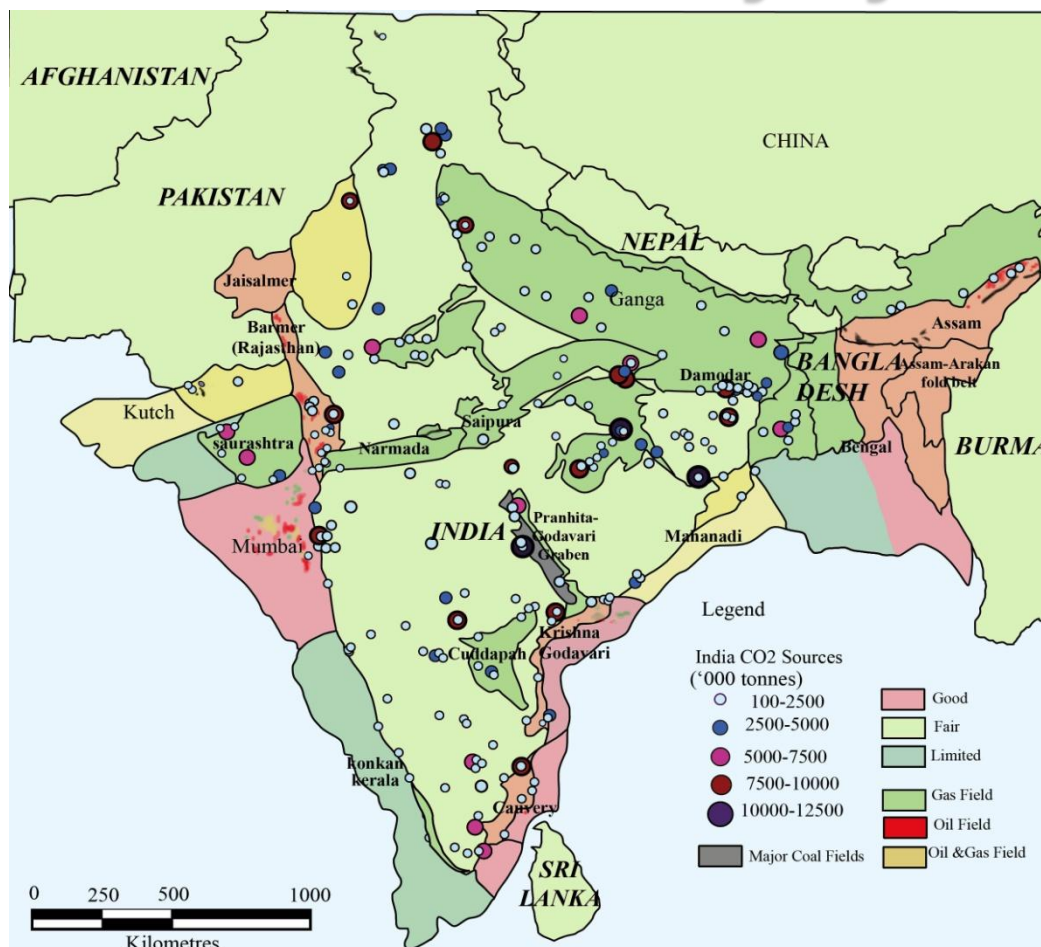


Asia – China





Asia – Indian Subcontinent 2008 IEA GHG Study by BGS





India Emissions

- Annual emissions: 1343 Mt
- Large point sources: ~ 660 Mt
- Expected to increase with installation of 9 Ultra Mega Power Plants
- Increase in the region of: 275 Mt/y
- Increase expected within 7 – 8 years



India Storage Potential

- Coal mined extensively throughout India, limiting the potential for storage to 345 Mt,
 - No single formation capable of storing more than 100 Mt.
- Limited data on the size and extent of oil and gas fields, although storage potential thought to be low.
- However, potential could exist in new off-shore discoveries of both oil and gas.
- Aquifers likely to represent best storage option, particularly in the NW and NE of the country.
- Large potential to store in Basalt formations?



Pakistan, Bangladesh and Sri Lanka

- Pakistan – 45Mtpa emissions from point sources
 - Depleted gas fields appear best option – 4 fields > 200Mt
- Bangladesh – 17Mtpa from point source emissions
 - Depleted gas fields – 2 fields > 200Mt
- Sri Lanka – very limited potential



Selected Other Regions and Nations

- Brazil – 2000Gt effective capacity (Carbmap)
- South Africa – atlas due April 2010
- Ireland – source-sink matching report
- Middle East – atlas initiative?

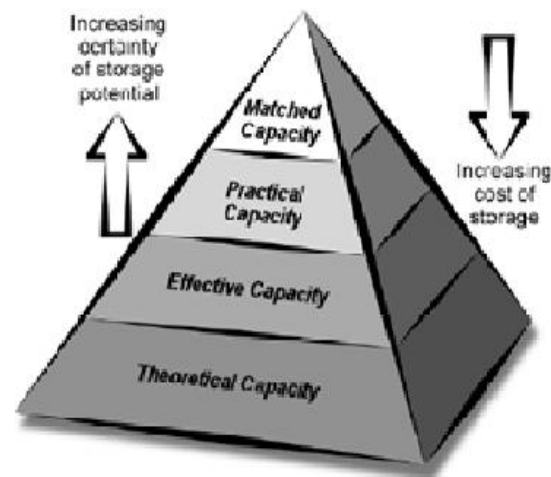


Global CO₂ Storage Capacity

IPCC 2005 estimates

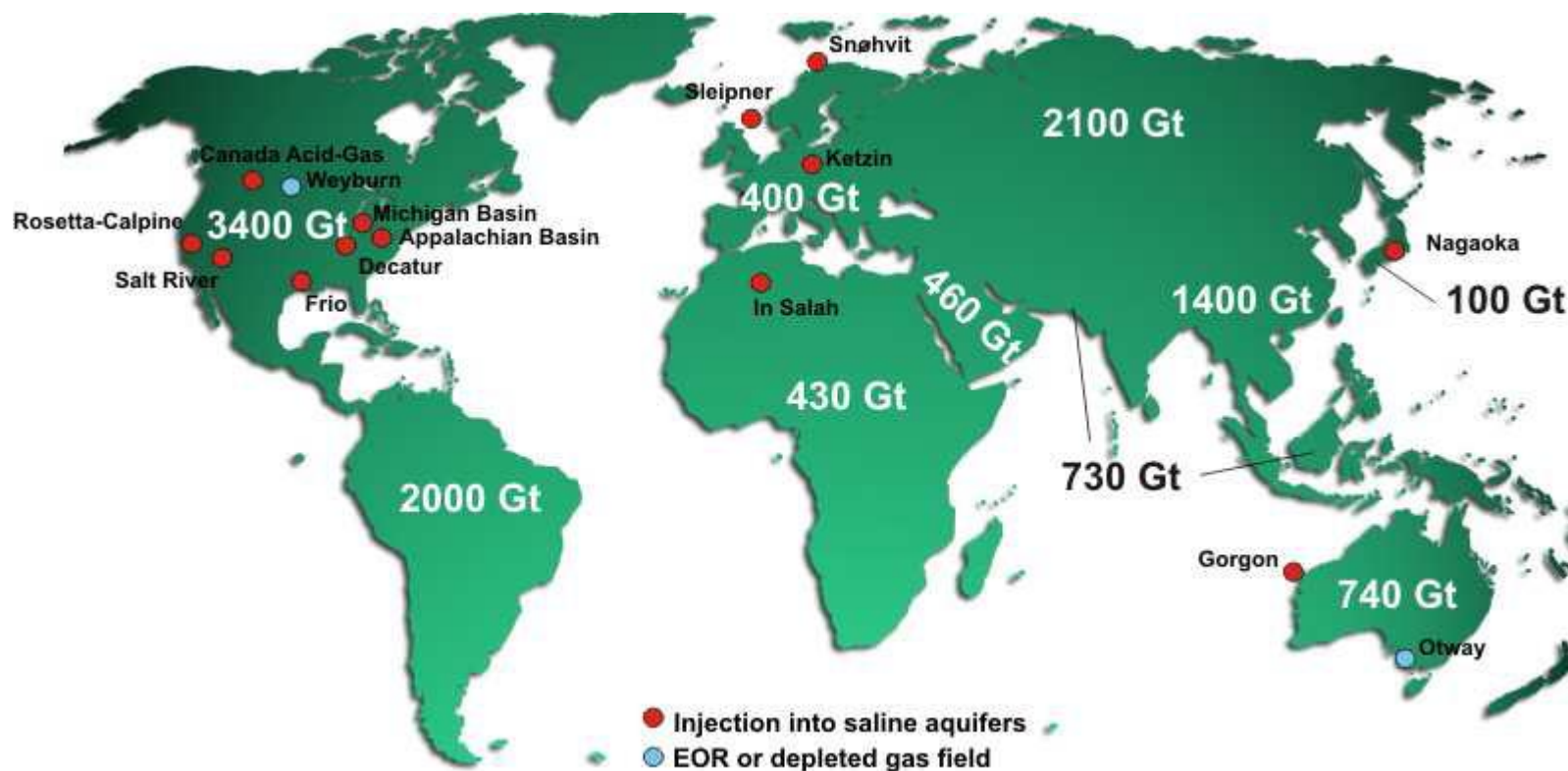
- 1,000 to 10,000Gt in saline aquifers
- 675 to 900Gt in depleted oil and gas fields
- 3 to 200Gt in coal beds

CSLF Resource Pyramid





'Theoretical' Storage Capacity Estimates





Depleted Gas Fields Study

- IEA GHG study undertaken in 2008 by Poyry Consulting, Element Energy and BGS
- Regional theoretical, effective and practical capacities calculated using USGS petroleum assessments
- Regional matched capacities calculated using AAPG Giant Fields database and GIS based source-sink matching



Simplifying Assumptions

- Many made, due to nature of study, e.g.
 - Total recoverable gas reserves converted to equivalent CO₂ capacities (0.7t/m³, GEF 200)
 - Reservoirs re-filled to original pre-production pressure
 - Minimum depth 800m
 - Minimum economic storage capacity of 50Mt onshore/100Mt offshore
 - Estimated dates for close of gas production

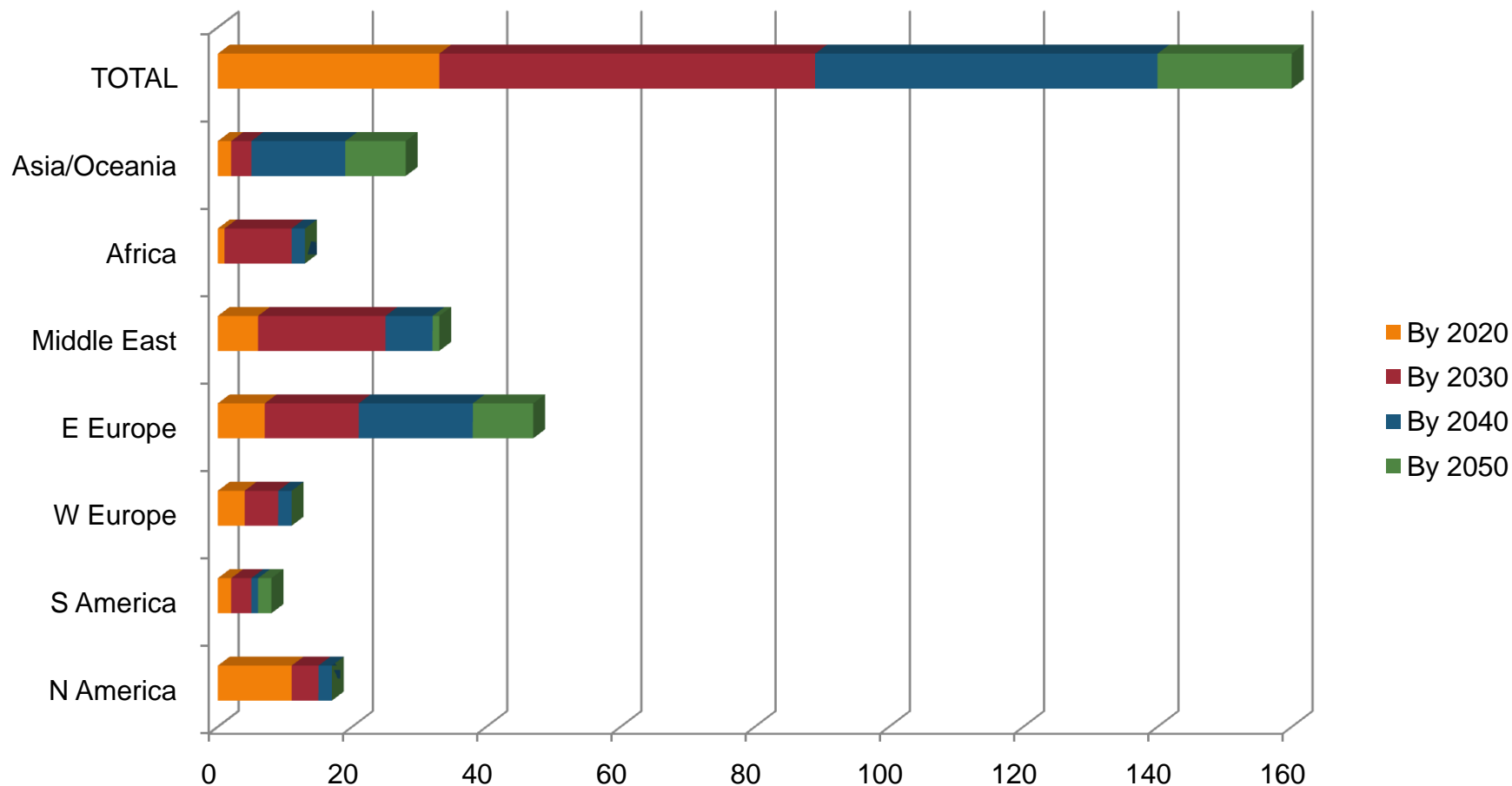


Global Gas Field Capacities from USGS Dataset

- **Theoretical** – *assuming all available pore space through gas production utilised* – **900Gt**
- **Effective** – *assumed 75% of theoretical to allow for geological & technical factors* – **680Gt**
- **Practical** – *discounting effective capacity by 40% to allow for sub-economic field size, and 1% of sites to be rejected due to risk assessment (leakage)* – **390Gt**



Matched Capacities (Gt) for Gas Fields



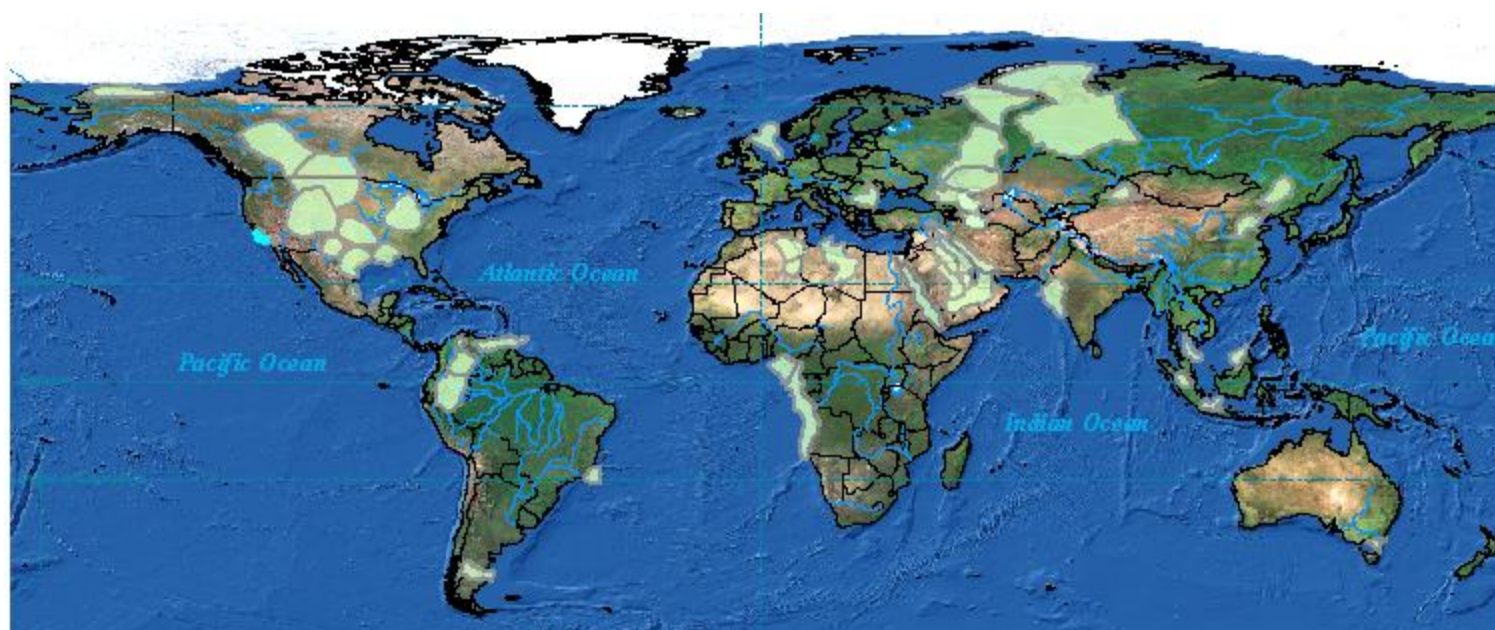


CO₂-EOR Study

- Undertaken by Advanced Resources International, based in the USA
- Global study involving:
 - Characterisation of hydrocarbon basins
 - Estimation of OOIP
 - Judgement of CO₂-EOR potential
 - Estimation of CO₂ storage potential
- Preliminary Results



IEA Greenhouse Gas R&D Programme



Asia & Pacific	9
Central and S America	7
Europe	2
Former Soviet Union	6
Middle East and Africa	13
North America	15



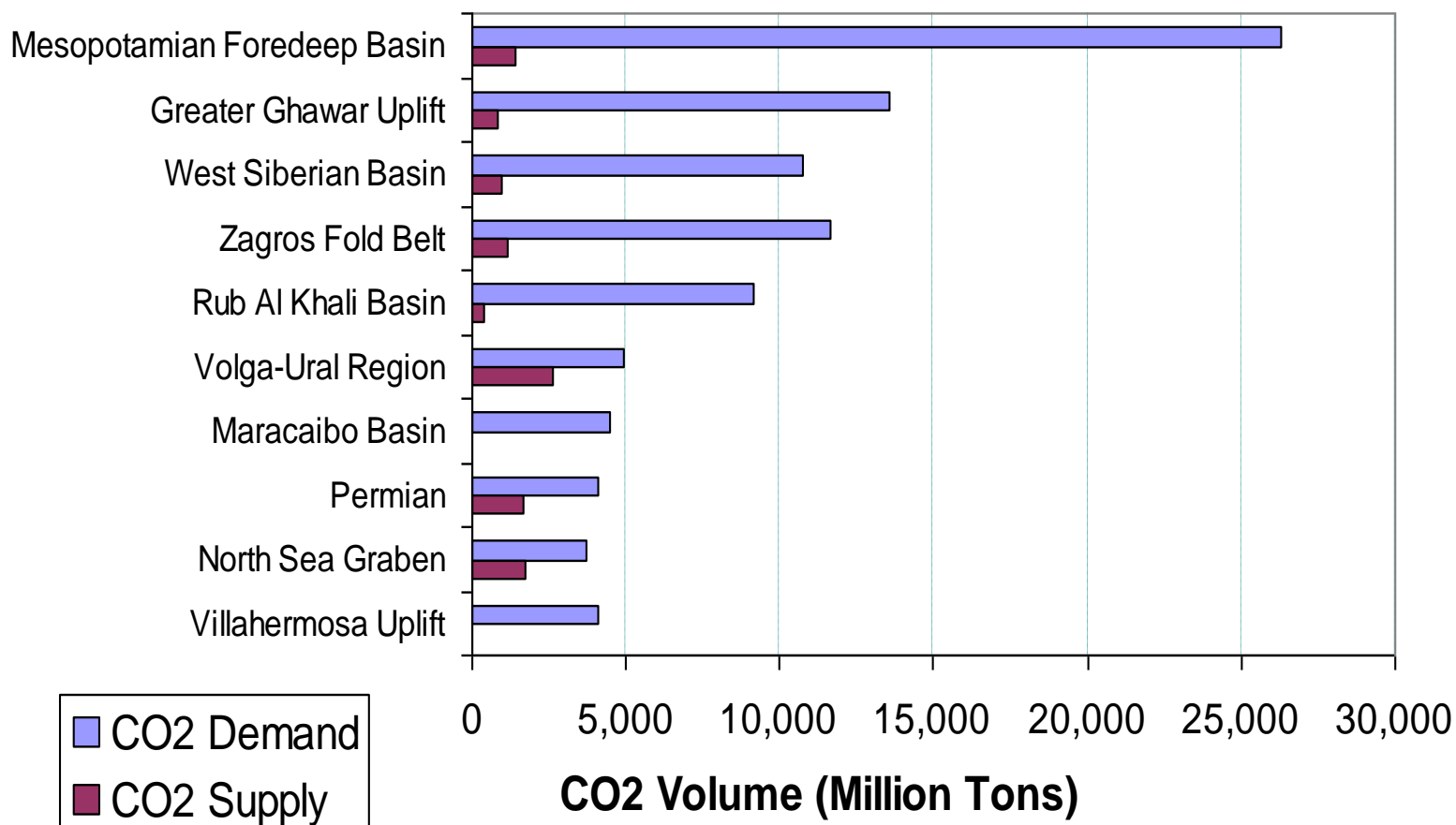
EOR Target

Rationale

Volume (Billion Barrels of oil)	% of OOIP		
2,156	48%	Oil Amenable for CO ₂ -EOR	Certain fields within a basin may be too shallow or contain oil too heavy for miscible CO ₂ -EOR operations
3,213	72%	Oil in Fields Accessible to CO ₂ -EOR Operations	Some reservoirs are too small, or otherwise inaccessible to CO ₂ -EOR operations
4,368	98%	OOIP in basins with favorable characteristics for CO ₂ -EOR operations	Five basins did not meet criteria for Miscible CO ₂ -EOR
4,465	100%	Total OOIP	The total volume of OOIP in the 52 basins will not be available for CO ₂ -EOR



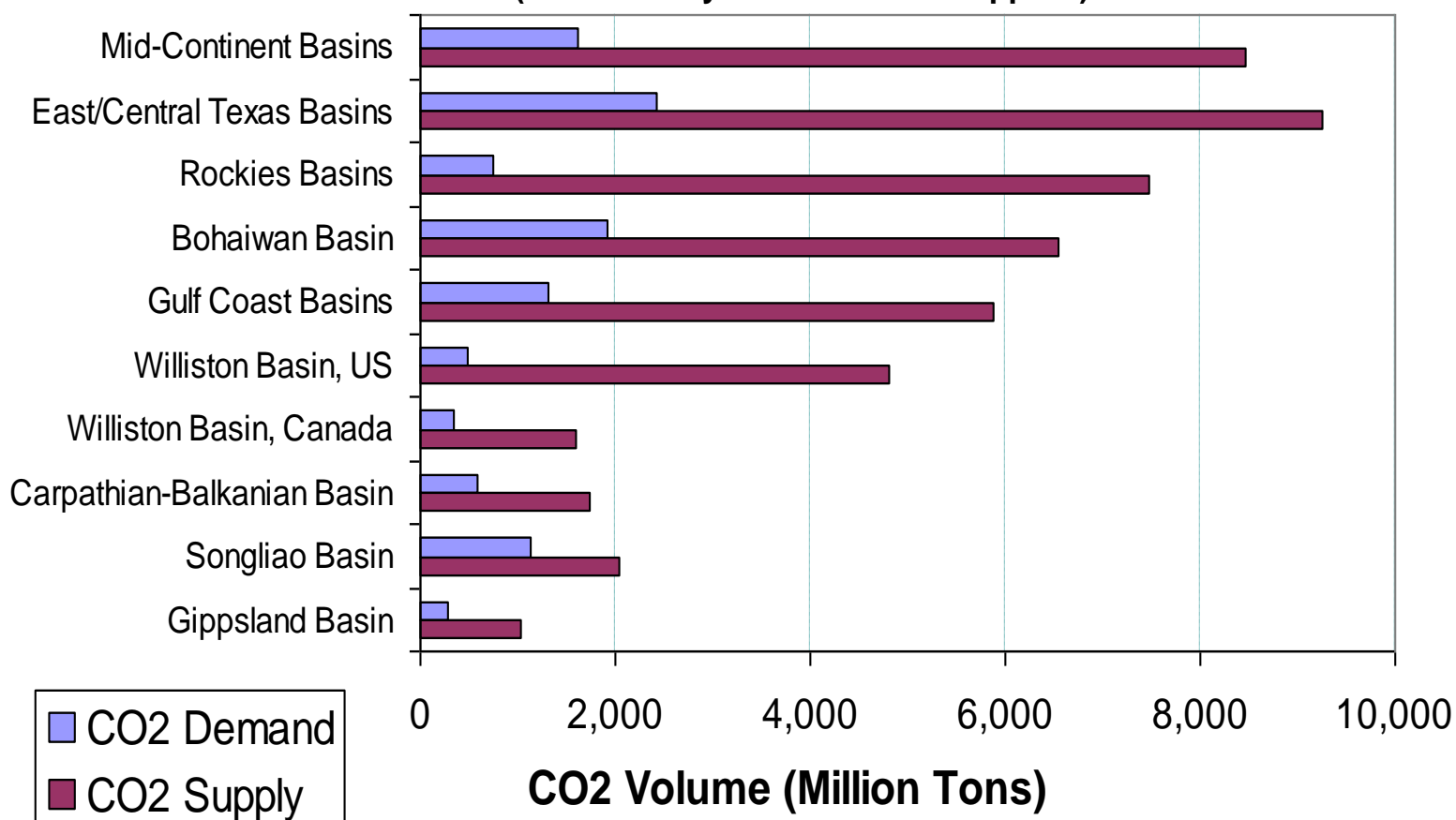
Top 10 World Basins for CO₂-EOR





Top 10 World Basins for CO₂-EOR

(As ranked by access to CO₂ supplies)





Revised CO₂ Storage Capacities

Storage Type	IPCC Estimated Global Capacity (Gt)	IEA GHG Estimated Global Capacity (Gt)
Saline Formations	1,000 to 10,000	
Depleted Gas Fields	675 to 900	160 to 390
CO ₂ -EOR		11 to 130
Coal Beds	3 to 200	



Conclusions

- GIS – based source-sink mapping undertaken in many regions/countries
- Source-sink matching being mainly used qualitatively or for assessment of specific areas
- ‘Atlas’ work in Australia, South Africa
- GCCSI intention to produce a global CCS atlas, with assistance from Geoscience Australia, IEA GHG and others



IEA Greenhouse Gas R&D Programme

- General - www.ieagreen.org.uk
- CCS - www.co2captureandstorage.info

